



INVESTOR IN PEOPLE

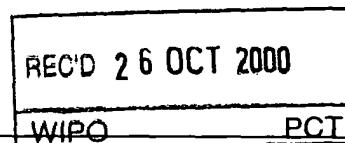
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The Patent Office  
Concept House  
Cardiff Road  
Newport  
South Wales  
NP10 8QQ

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GB60/3538



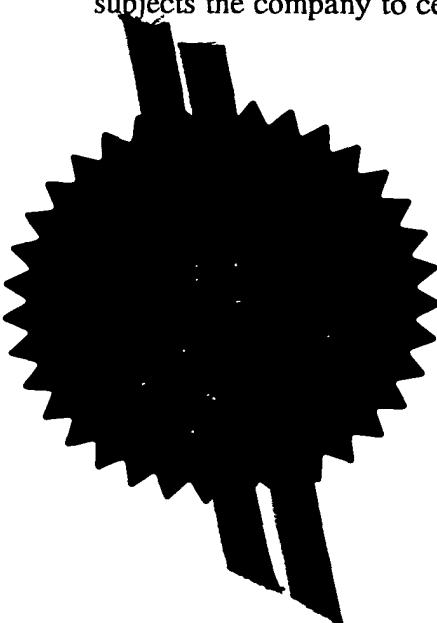
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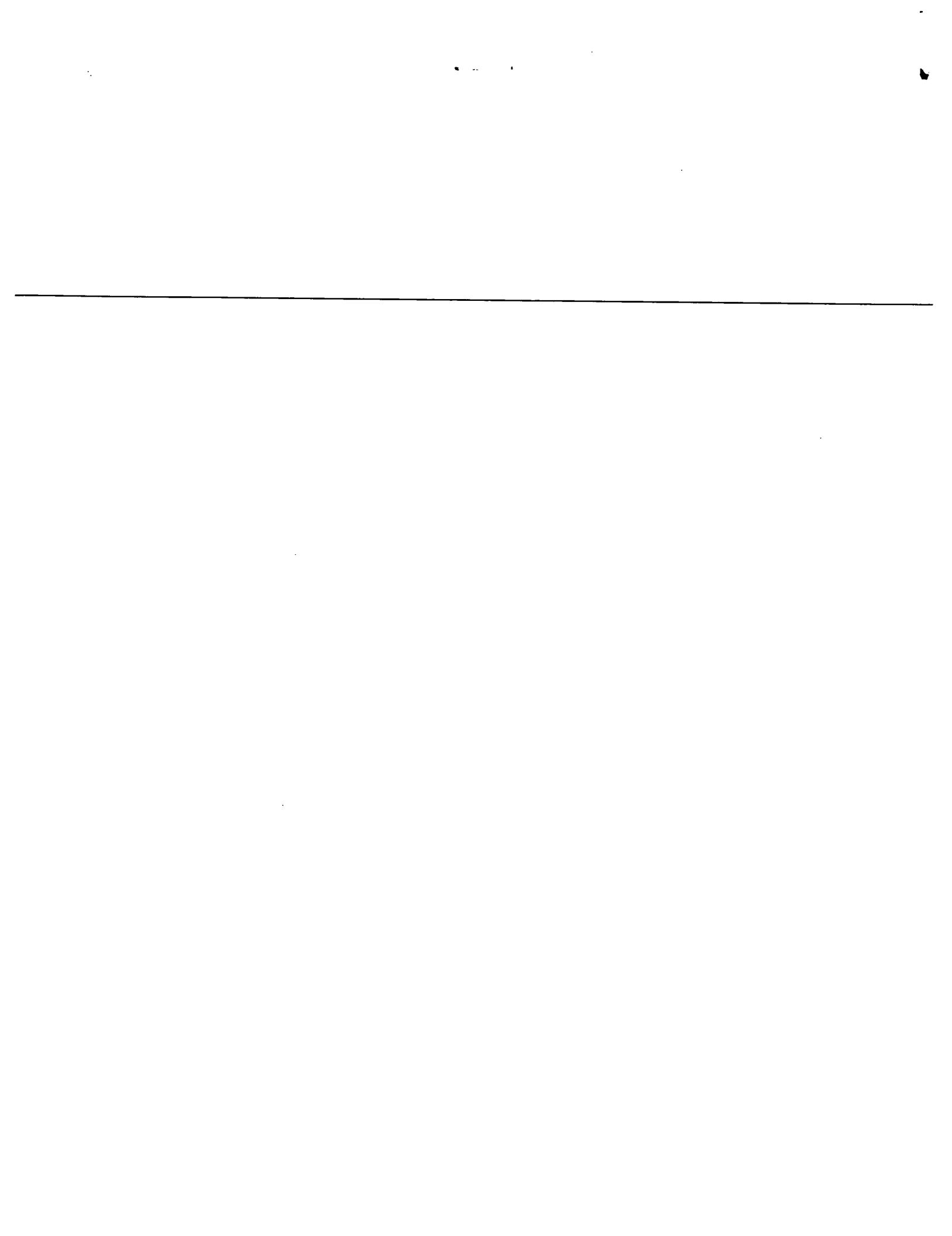
Signed

Dated

11 October 2000

## PRIORITY DOCUMENT

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14 SEP 1999 0476344-1 005016  
14 SEP 1999 0476344-1 005016**Request for grant of a patent***(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)*

The Patent Office

Cardiff Road  
Newport  
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1. Your reference

SAJ/NP1040UK

2. Patent application number

*(The Patent Office will fill in this part)*

9921534.5

14 SEP 1999

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*Intersurgical Limited  
Crane House  
Molly Millars Lane  
Wokingham  
Berkshire RG41 2RZThe University of Leeds  
Leeds  
LS2 9JT

5863774002

Patents ADP number *(if you know it)*

5838370003

If the applicant is a corporate body, give the country/state of its incorporation

England

4. Title of the invention

Manufacture of Electrostatic Filtration Media

5. Name of your agent *(if you have one)**"Address for service" in the United Kingdom to which all correspondence should be sent  
(including the postcode)*

Lewis &amp; Taylor

49 Stoney Street  
Nottingham  
NG1 1LX

THE PATENT OFFICE

14 SEP 1999

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Patents ADP number

07636228001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country

Priority application number  
*(if you know it)*Date of filing  
*(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
*(day / month / year)*8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

Yes

- a) *any applicant named in part 3 is not an inventor, or*
- b) *there is an inventor who is not named as an applicant, or*
- c) *any named applicant is a corporate body.*

*See note (d))*

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description 6

Claim(s)

Abstract

Drawing(s)

1 + 1



10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents  
(please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature

Date

13 September 1999

12. Name and daytime telephone number of person to contact in the United Kingdom

Dr S A Jones

0115 924 2969

#### Warning

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#### Notes

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.
- Write your answers in capital letters using black ink or you may type them.
- If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
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- For details of the fee and ways to pay please contact the Patent Office.

Title: Manufacture of Electrostatic Filtration Media

This invention relates to the manufacture of electrostatic filtration media.

US-4,798,850 describes the formation of filter material with a felt structure composed of a blend of clean polypropylene fibres and clean fibres of an addition polymer comprising one

5 or more halogen-substituted hydrocarbons. The felt is made by carding fibres into a web before cross-lapping and needling them to form a coherent fabric structure.

In the carding operation, fibres are worked by a series of toothed rollers, which serve to disentangle the fibre and provide some mixing to increase the homogeneity of the blend. The product from the carding machine is a continuous web, which is peeled from the last main

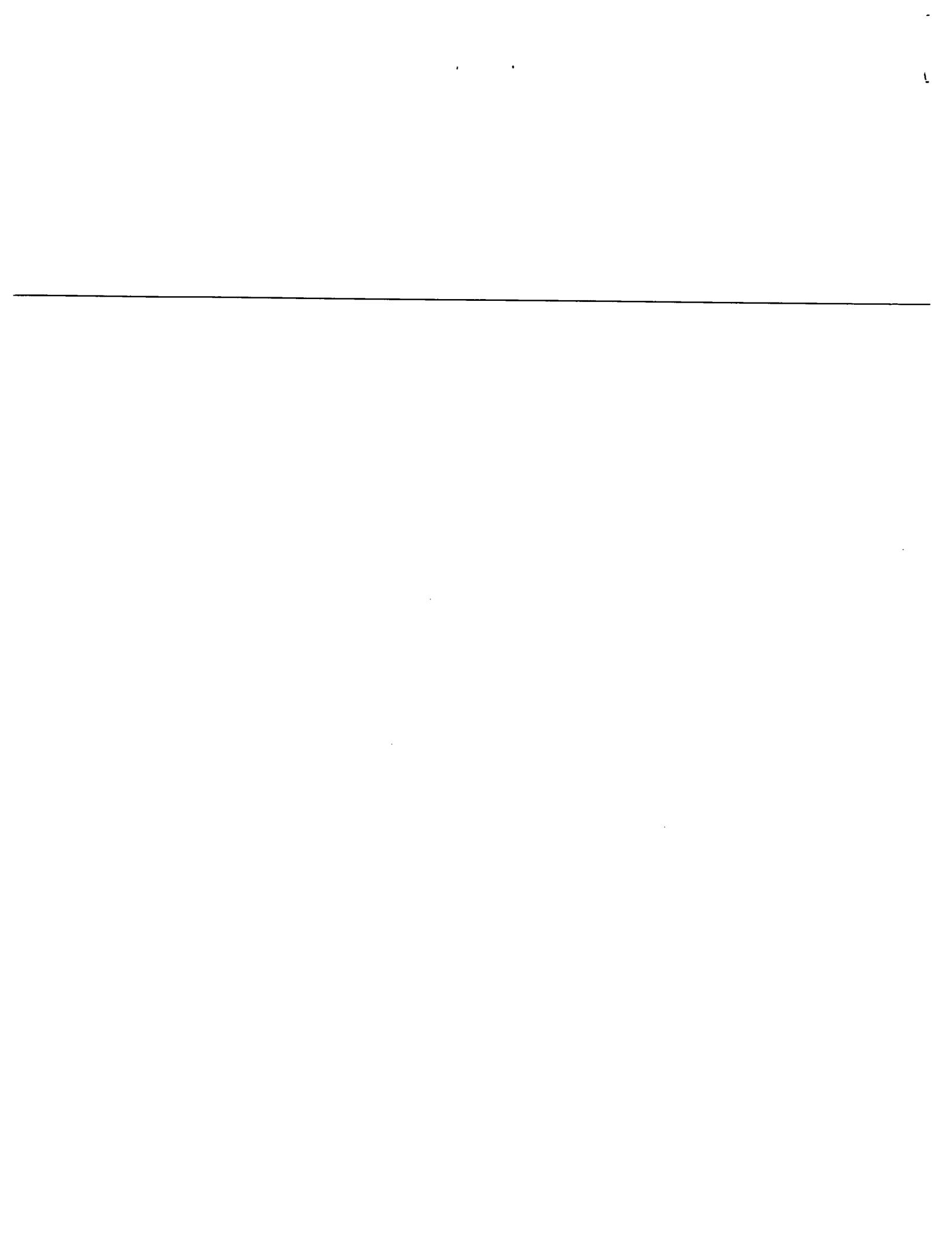
10 roller on the machine (doffer). The orientation of fibres in the web leaving the doffer is substantially dictated by the orientation of fibres leaving the doffer and is predominantly in the machine direction. In carding, the assembly of the web takes place mainly on the doffer and fibres are controlled by fibre to metal friction in the machine.

There has now been devised an improved method of forming nonwoven filter materials  
15 which offers significant advantages over the prior art.

According to the invention, there is provided a process for the manufacture of an electrostatic filtration medium, which process comprises air-laying fibres to form a nonwoven web.

The process according to the invention is advantageous over the prior art in several respects, including the following:

20 (i) The fibre orientation in the web is more random (owing to the dispersion of loose fibres in air immediately before web formation). Web properties are consequently more isotropic.



(ii) No carding or cross-lapping step is required (as compared to the prior art) and consequently the resulting structure does not consist of individual layers of web assembled one on top of the other. A single integrated structure is produced.

5 (iii) The air-laid web structure can be characterised by pronounced orientation in the z-direction (or perpendicular to the web surface). This gives the structure higher bulk (for a given area density) than a carded and cross-lapped web.

(iv) Using the sifting air-lay approach, fibres of 2-12mm can be converted into uniform web structures (in contrast to the prior art, which permits only lengths of typically 15-200mm to be processed (due to restrictions imposed by carding).

10 (v) A shorter web formation process is achieved as compared to carding and cross-lapping.

(vi) Providing it is clean, short, waste polypropylene fibre can be used in the process assuming the length is at least 2mm. Such short fibres are incompatible with the carding process.

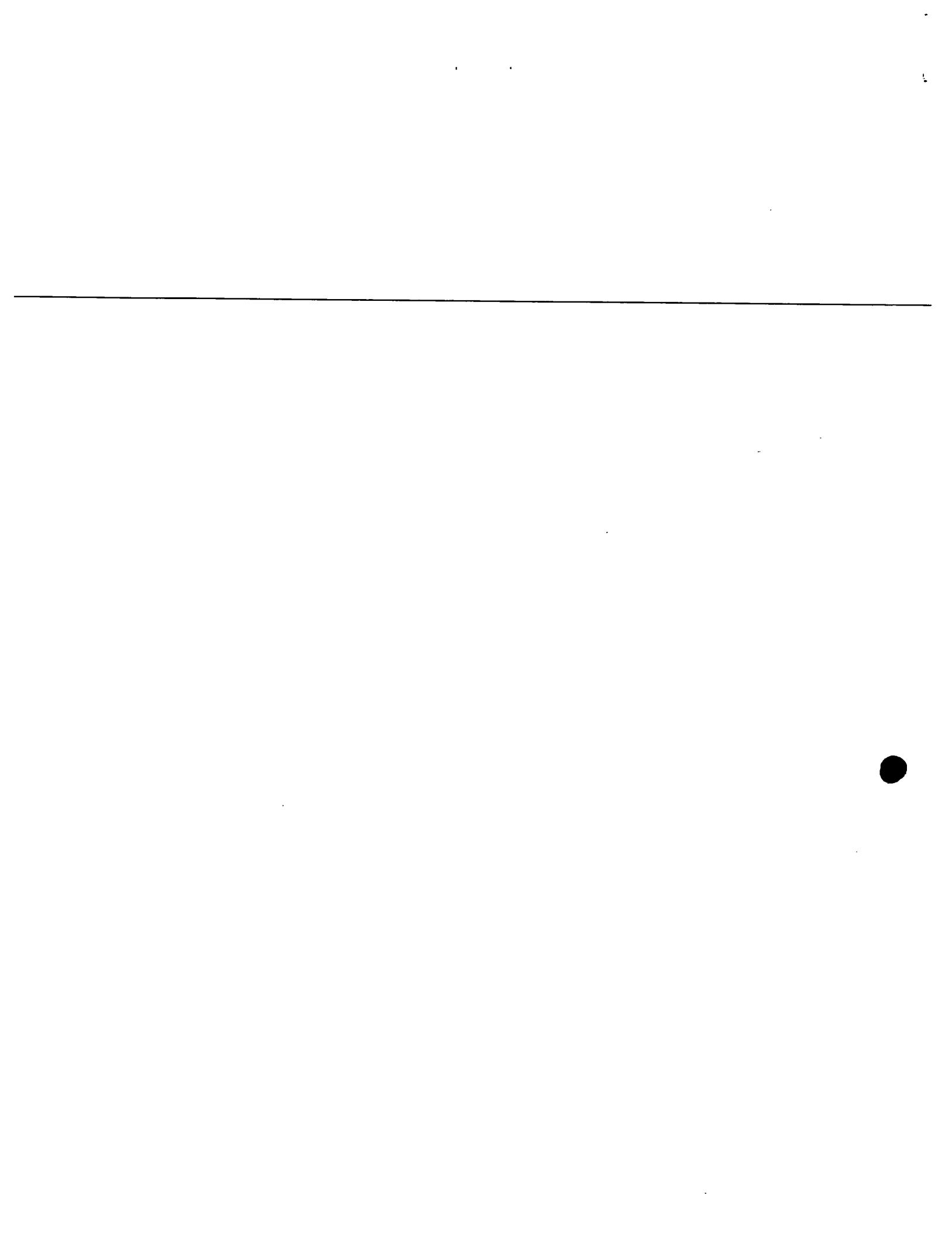
15 In the air-laying process, the manner of web formation is substantially different from the prior art and marked differences in fabric properties are obtained. In air-laying, fibres are transferred to either

(a) a rapidly rotating cylinder clothed with teeth and interacting with either other toothed rollers or fixed carding plates or

20 (b) a sifting screen or rotor device in which fibres are circulated over a mesh screen and then passed through an air-stream to form a web structure.

In both processes, the mechanical working treatment is much shorter than that used in carding but is sufficient to electrostatically charge the fibre. Electrostatic charging of the fibres is achieved as the fibres are opened on the clothed cylinders or as they are contacted

25 by the rotors and mesh yarns of the grid. In contrast to carding, the charged fibres are then



dispersed freely in a moving air stream to form an air/fibre mixture. The air then transports fibres from the rotating cylinder (or sifting area) to a suctioned mesh conveyor belt, screen or drum where the fibres are landed to form the web. The belt/drum acts as an air/fibre separator. The process is continuous and web weight depends on the speed of the landing  
5 drum or conveyor.

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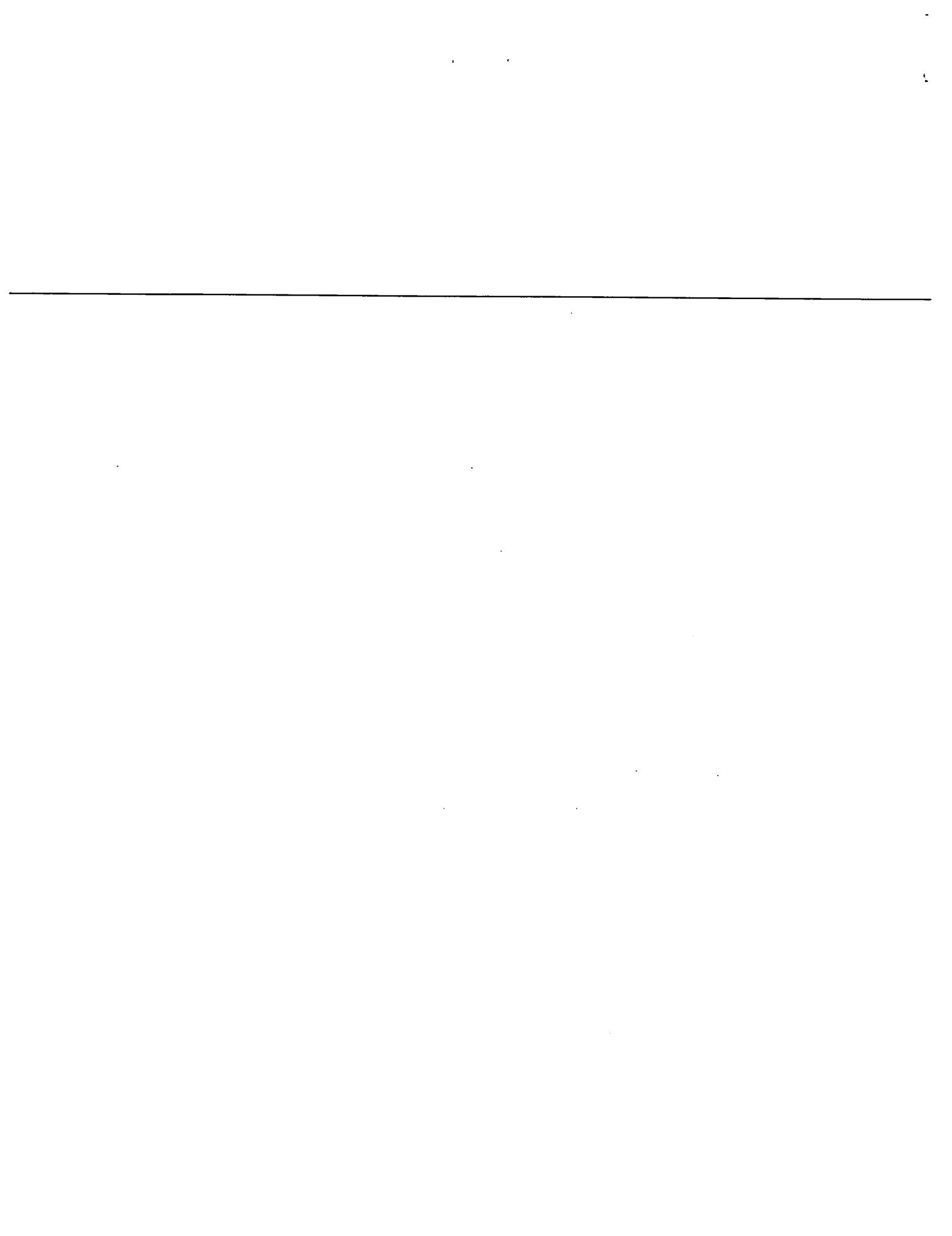
After web formation, consolidation of the web structure may be achieved using needlepunching.

As mentioned above, the properties of the web formed in the process according to the invention are more isotropic than in the prior art. This may manifest itself in a lower ratio  
10 of the tensile strengths of the web in the machine and cross directions (MD:CD), ie the longitudinal and transverse directions of the web as it is manufactured. Thus, according to a second aspect of the invention there is provided a filtration medium comprising a nonwoven web of fibrous material, said web having an MD:CD ratio of less than 2:1. More preferably, the MD:CD ratio is less than 1.5:1.

15 Preferably, a blend of two or more types of fibre is used in the process of the invention. Most preferably, the blend comprises (a) a polyolefin and (b) an addition polymer comprising one or more halogen-substituted hydrocarbons. The former component of the blend is preferably polypropylene and the latter may be, for instance, polyvinylchloride or polyvinylidene chloride.

20 The blend may contain other fibres, either alternatively or in addition to those mentioned above. Examples of other fibre types which may be included are polyethylene and "modacrylic", ie a copolymer comprising from 35 to 85 weight percent acrylonitrile units and preferably having the balance made up substantially of other addition-polymer-forming units, being halogenated hydrocarbon such as vinyl chloride or vinylidene chloride.

25 The components of the blend may be present in any suitable proportions. Preferably, the weight ratio of (a):(b) is in the range 70:30 to 30:70. Most preferably, the two classes of fibre



are present in approximately equal proportions.

Preferably, the linear density of the two classes of the fibres in the blend is similar and is in the range 0.1-10 dtex (dtex = weight in grammes of 10,000m of fibre). Most preferably, the fibres are of less than 3.3 dtex. In terms of fibre diameter, the diameter is most preferably

5 12µm or less.

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The fibres are preferably substantially free from any fibre finishes, oils or other extraneous matter prior to blending. Such chemicals are ideally removed from the fibres by an aqueous scouring process using a solution containing a synthetic detergent, sodium carbonate or a potassium carbonate solution. Other scouring regimes may also be suitable. The scouring

10 process should be followed by thorough rinsing and drying stages prior to further processing.

Likewise, all mechanical processing machinery must be thoroughly cleaned, preferably by chemical means, to remove all fibre finish, waxes, grease, anti-static agents or other chemical residues.

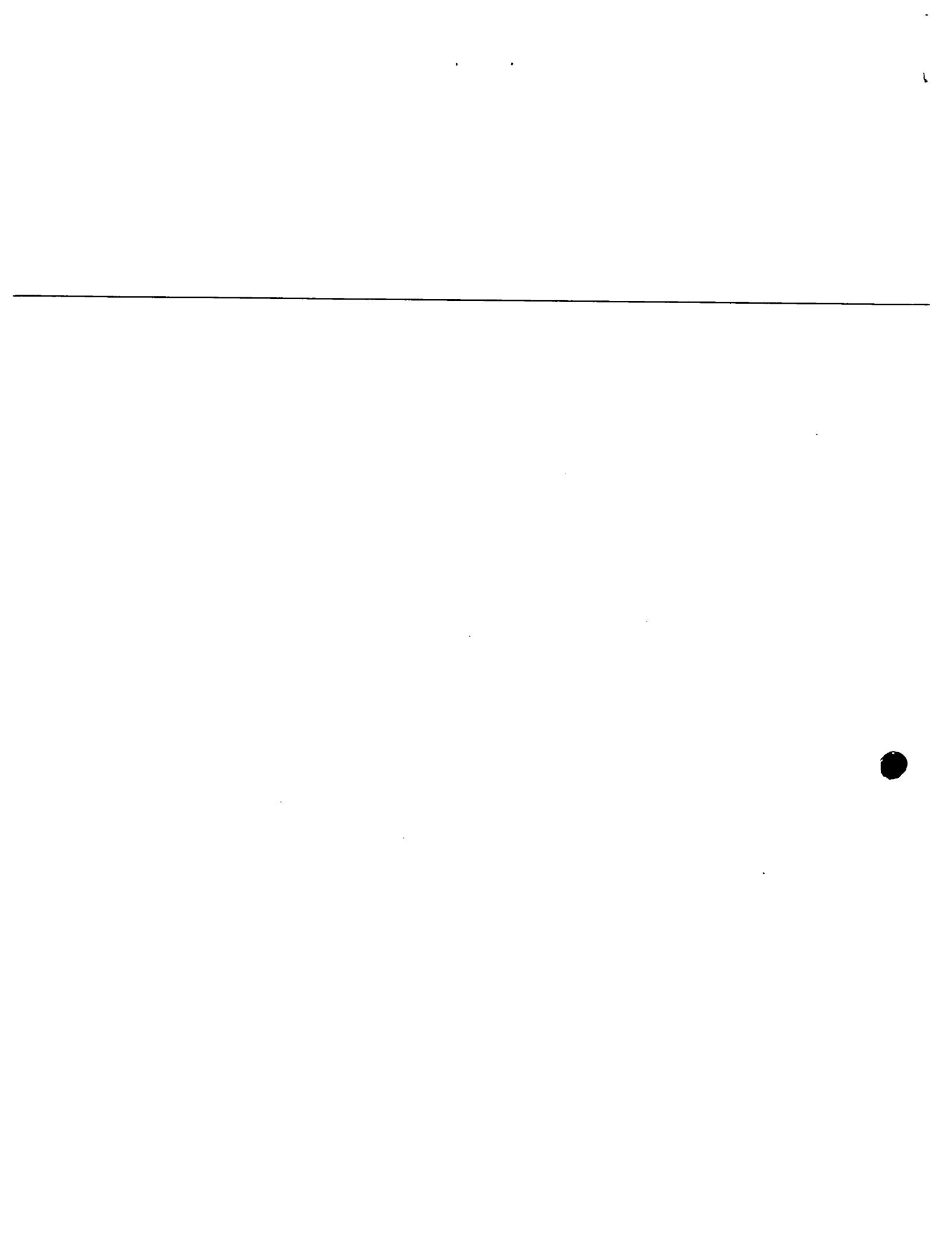
Currently preferred embodiments of the invention will now be described in greater detail, by  
15 way of illustration only, with reference to the accompanying drawings, in which

Figure 1 is a schematic diagram of a roller-based air-laying process; and

Figure 2 is a schematic diagram of a sifting-based air-laying process.

#### Roller-Based Air-Laying

As illustrated in Figure 1, in a roller-based air-laying process raw fibres are transferred first  
20 from a feed conveyor 11 to a clothed feed roller system 12 and then to a rapidly rotating cylinder 13 which is clothed with teeth and interacts with fixed carding elements 14,15 or some other clothed surface (eg clothed rollers). Electrostatic charging of the fibres is achieved as the fibres are opened on the clothed cylinders 12,13. An air knife 16 displaces



fibres from the cylinder 13 on to a perforated conveyor 17 to which suction is applied from below. A nonwoven web of fibre is built up on the perforated conveyor 17 from which the web is drawn off and consolidated by needlepunching.

### Sifting-Based Air-Laying

5 A sifting-based air-laying process is illustrated in Figure 2. In such a process, loose fibre is contained within a drum 21 having a grid 22 at its base. Rotors 23 within the drum 21 displace fibres in an air stream on to the top surface of a perforated conveyor 24, to which suction is applied from below. Again, the nonwoven web is built up on the conveyor from which it is drawn off and consolidated by needlepunching. Air flow in the system is  
10 constrained between a pair of rollers 25,26, the downstream one of which 26 also applies compression to the web.

### Fibre Blends

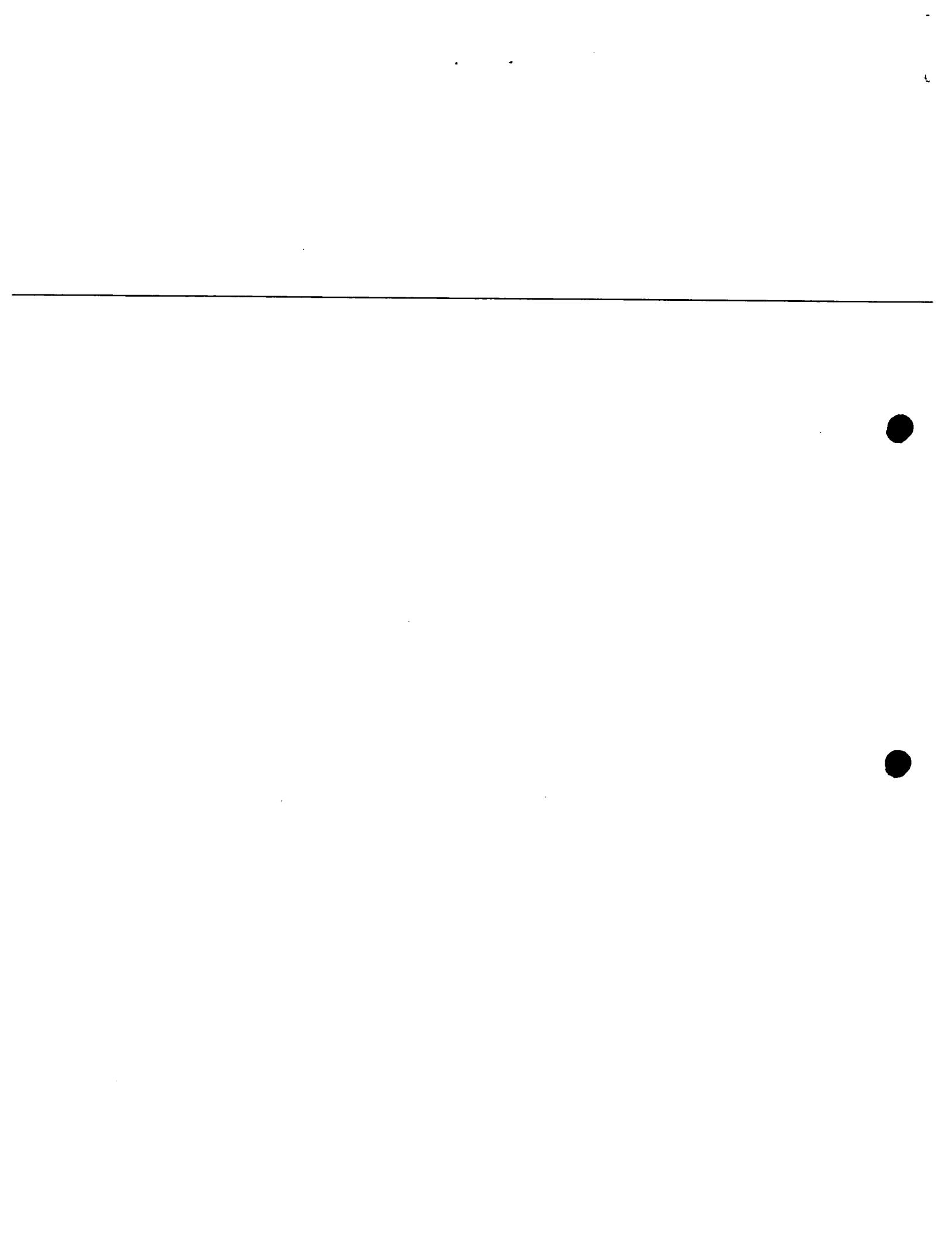
Examples of fibre blends which may be used are:

a) Polyvinylchloride  
15 Polypropylene

b) Polyvinylchloride  
Modacrylic

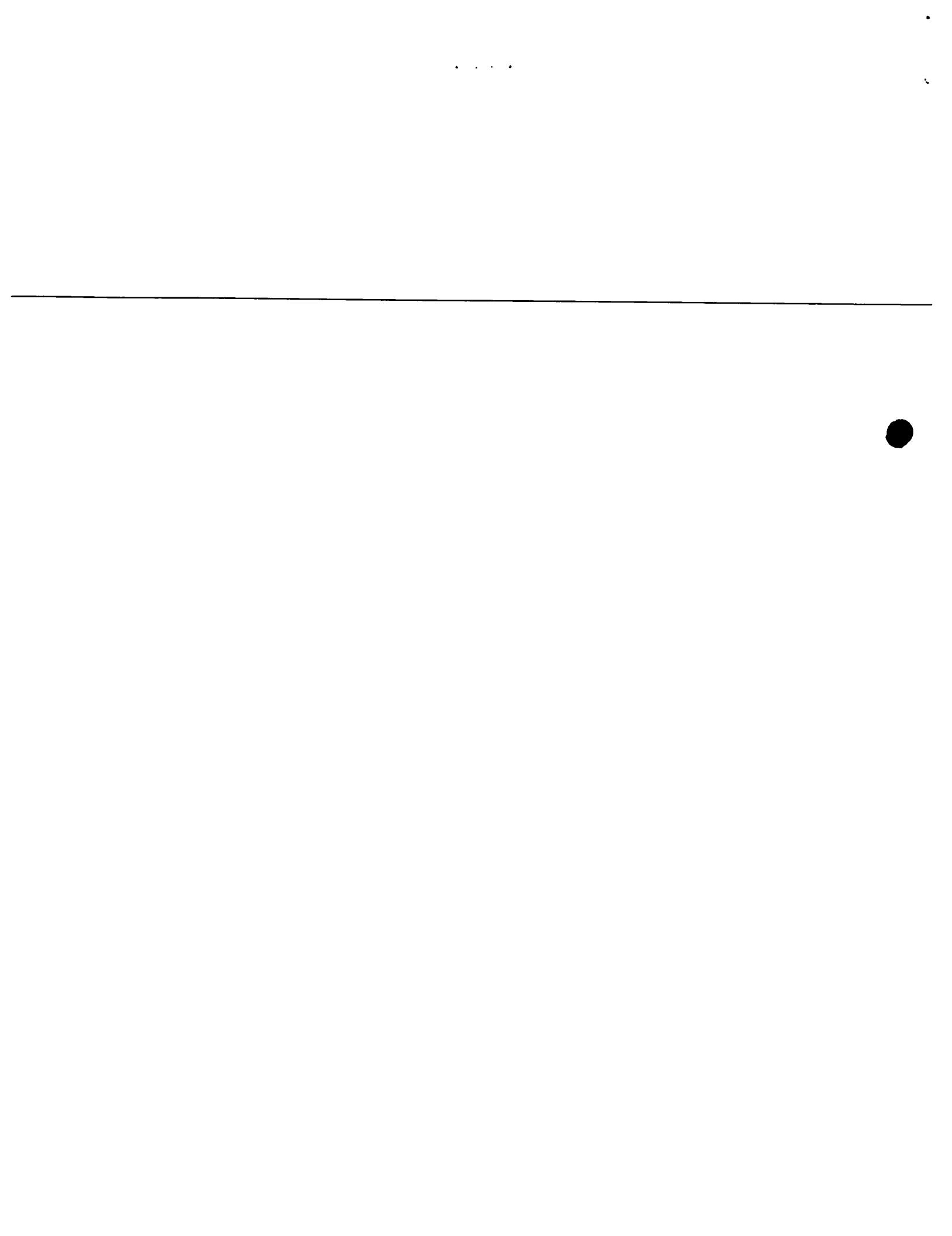
c) Polyvinylchloride  
Polypropylene  
20 Polyethylene

d) Polyvinylchloride  
Modacrylic  
Polyethylene



In each case, the proportion of PVC in the blend is approximately 50%. All the fibres have diameters of 12 $\mu$ m or less and lengths in the range 2 to 12mm.

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FIG 1

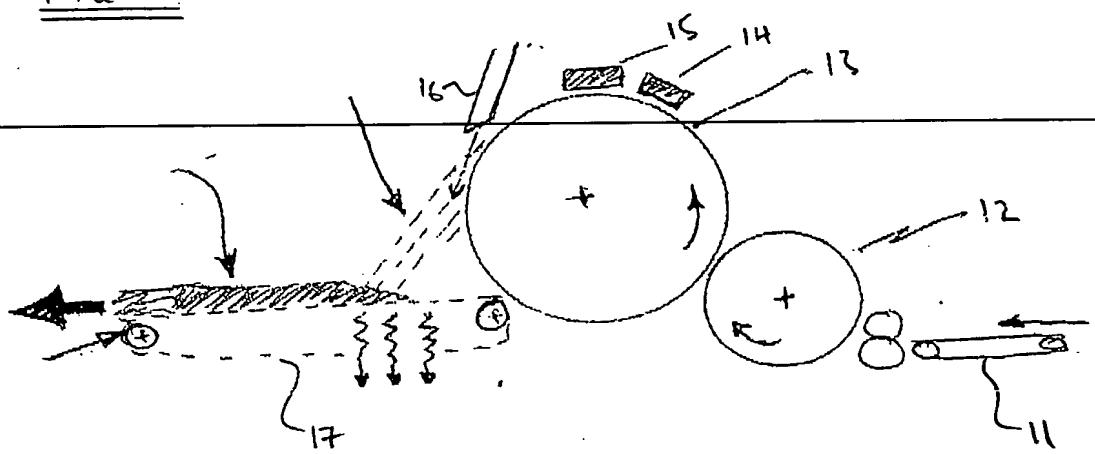
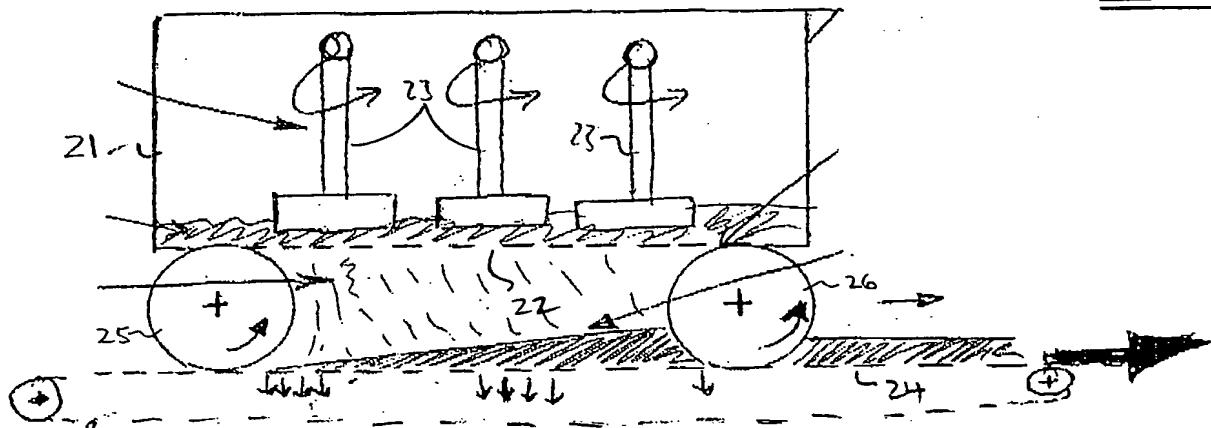


FIG 2



PC1/eB 00/03538

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